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ABSTRACT

"Exploring Old Growth Forests" is an Ontario (Canada) program that provides secondary students with hands-on experiences in old growth forests. Activity-based and student-centered, the program aims to develop student awareness of the importance of old growth forests and the need to conserve them. This manual provides teachers with background information and detailed instructions for student activities in the forest. Background information covers general characteristics of old growth forests; reasons why such forests are valuable; old growth forest ecology and the influences of water, light, and fire; and the importance of old growth forests to birds, other wildlife, and the ecological web. A program overview discusses pretrip organization, lists equipment needs, suggests tree identification guides, and recommends steps for choosing and laying out a forest study plot. Field activity descriptions include objectives, equipment needs, additional background information, instructions, forms for data collection, illustrations, and summary questions for students. Activities are arranged in four sections: (1) identification and measurement of live trees and estimation of site productivity; (2) identification and classification of snags (dead standing trees) and observation of wildlife activity on snags; (3) classification and measurement of logs (downed woody debris); and (4) identification and measurement of young trees (forest regeneration) and identification of nonwoody plants. A final section provides old growth baseline data for eastern deciduous and coniferous forests and presents a behavior code for students. (SV)

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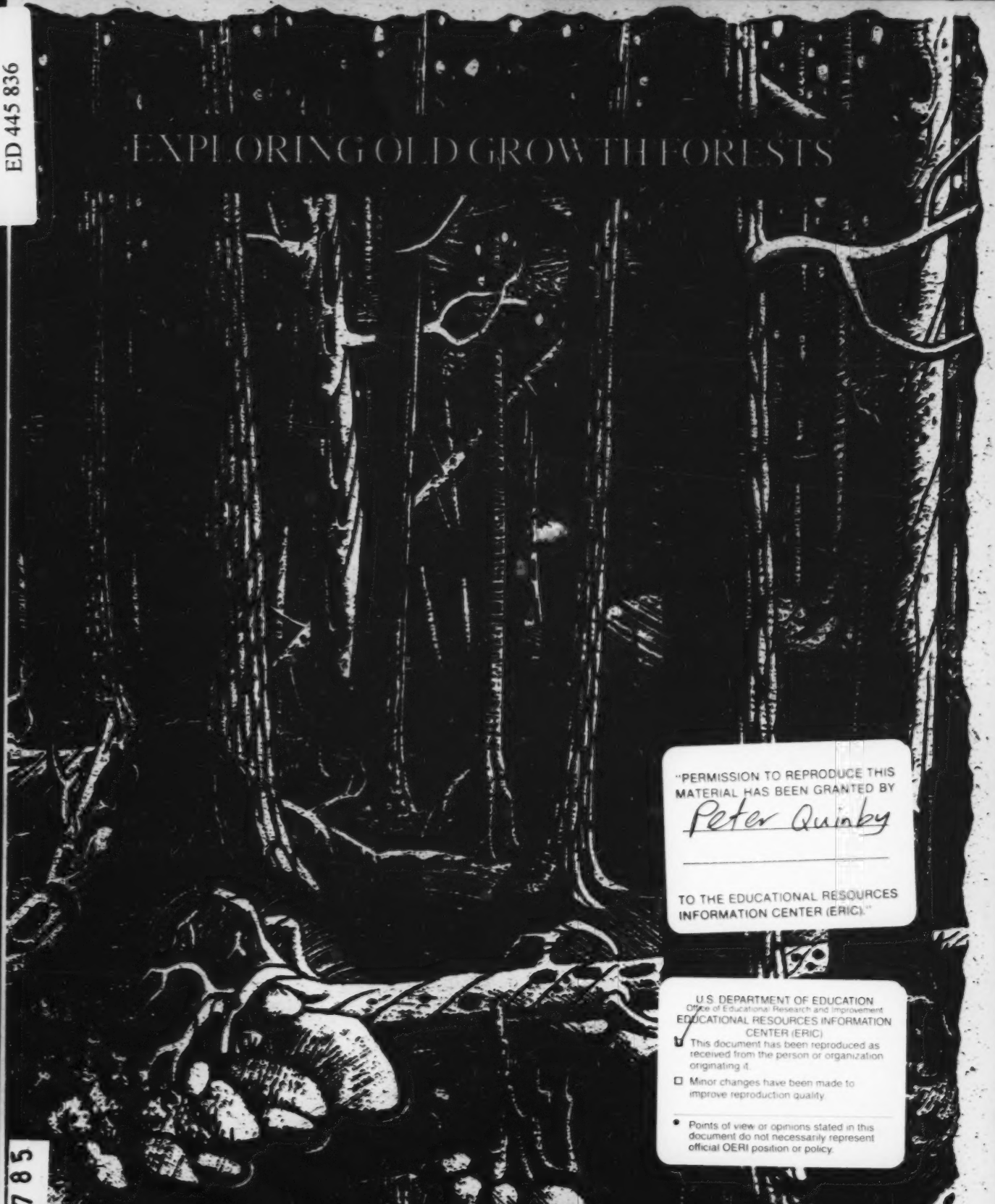
EXPLORING OLD GROWTH FORESTS



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A TEACHER'S MANUAL

RC021785

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EXPLORING OLD GROWTH FORESTS

A TEACHER'S MANUAL

by

Chris Lemieux
Jennene Powers
Peter Quinby
Caroline Schultz
Mark Stabb

CANADIAN NATURE FEDERATION

FÉDÉRATION CANADIENNE DE LA NATURE

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ANCIENT FOREST EXPLORATION AND RESEARCH

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Acknowledgements

The conservation of our forests is vitally important to all citizens of Ontario. One way to ensure that people become involved and concerned with conserving forest biodiversity is through education. Only when we begin to understand the complexity of forest ecosystems can we appreciate the need to conserve them.

Exploring Old Growth Forests — A Teacher's Manual is part of an education project inspired by the many volunteers who have worked with Ancient Forest Exploration and Research on old growth red and white pine surveys in northern Ontario. Their enthusiasm as researchers and old growth advocates made us ask how we could interpret this work for a wider audience.

The result is this curriculum-based education program and a field guide entitled *Ontario's Old Growth — A Learner's Handbook*. We designed the teacher's manual to open the world of old growth to students using a series of field activities to explore the components of these forests. The techniques used are ones developed by researchers working to classify old growth ecosystems and unravel the ecological mysteries they contain. It can nicely complement the Ontario Ministry of Natural Resources' *Focus on Forests* education program that deals with a wide spectrum of topics in forest ecology and management.

Many people helped develop this program. We would like to thank all the volunteers who helped refine the field survey techniques in the Upper Spanish forest during the summer of 1994. Thanks also go to Tom Lee, Fiona McGuinness and Mike Henry of Ancient Forest Exploration and Research for organizing and helping run two school field trips to test-drive the study techniques. Many thanks also to the students from Espanola High School and Elliott Lake Secondary School and their teachers, Lindsay Killen, Ken Naples and Heather Walker, for participating enthusiastically in these trips.

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Finally, we greatly appreciate the financial support of the Environmental Partners Fund of Environment Canada and the Richard Ivey Foundation. We are very pleased to have had the opportunity to work with sponsors who share our vision of conservation through education.

Caroline Schultz
Director of Conservation Programs
Canadian Nature Federation

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EXPLORING OLD GROWTH FORESTS IN ONTARIO

INTRODUCTION

Very few old growth forests remain in Ontario after almost two centuries of logging. The vast white pine forests of the northern temperate region have been reduced to only a few scattered remnants and almost no old growth deciduous forests remain in southern Ontario. What would we lose if **all** of these forests were harvested?

We know that old growth forests provide wildlife habitat, store carbon and preserve a measure of biodiversity, all important reasons to save these forests. But what secrets do old growth forests hold that we have yet to discover? Our understanding of these ecosystems is limited and foggy. Fortunately we still have some time to set aside tracts of old growth forest and to gain a full understanding and appreciation of their uniqueness.

The **Canadian Nature Federation (CNF) and Ancient Forest Exploration and Research (AFER)** present this education program as an opportunity for students and teachers to explore the characteristics of old growth forests. Students will participate in active hands-on experiences exploring, measuring, identifying and mapping aspects of a forest plot. The information collected will be compared with what little is known about old growth forests to determine if the forest plot studied possesses any of the characteristics of old growth.

Ontario's Old Growth Forests Policy Advisory Committee, an independent group of volunteers from across the province, was established in January 1992. The primary mandate of the Advisory Committee was to develop a strategy for conserving old growth forest ecosystems in the province. The Committee's final report stated that:

> "Old growth forests are important ecologically, culturally, economically, and socially; locally, provincially and globally. And the next steps in conserving these important ecosystems must be taken without delay...".

Participation in this education program is one of the practical steps we can take toward eventually saving old growth forests. It is through awareness and understanding that individuals can be encouraged to take the action necessary to ensure the survival of these ecosystems.

OBJECTIVES

EXPLORING OLD GROWTH FORESTS is an education program designed for students from grade 9 to OAC. The overall objective of the program is to promote a better understanding of and appreciation for old growth forests.

Some of the specific objectives are as follows:

1) To educate students about old growth forests through hands-on experiences.

2) To develop an understanding of the forest as a complex community of living and non-living components.

3) To help students gain an awareness and appreciation of the importance of old growth forests and the need to conserve them.

4) To learn the skills of tree identification, measurement and mapping in a forest study plot.

5) To become familiar with the process of natural area inventory by investigating the species composition of the forest, the age distribution of the trees, and the productivity of the forest.

6) To learn the skills required to identify the decay class and species of dead standing trees (snags) found within a forest plot. The students will also learn to assess the suitability of the snags for wildlife by classifying the snag and making observations of wildlife activity. Students will learn the value of snags in a old growth forest ecosystem.

7) To learn the skills required to identify the decay class and species of downed logs (downed woody debris) found within a forest plot. Students will learn the value of downed logs in a old growth forest ecosystem.

TEACHING STRATEGY AND CURRICULA LINKS

The program is designed to be activity-based and student-centred. Students will be encouraged to learn through **observation, quantitative measurement, identification, assessment and mapping.** The development and application of practical inventory skills will provide students with an opportunity to be involved in data collection that eventually leads to critical analysis.

The program is interdisciplinary and can be linked to the curricula of **Science, Geography, Biology and Science in Society.**

HOW TO USE THE MANUAL

This manual is designed to help teachers easily lead students through a variety of activities by providing background information and detailed instructions.

The **OLD GROWTH BACKGROUND INFORMATION** is meant to provide both teachers and students with basic information concerning old growth forest ecology. More detailed information can be found by consulting some of the references listed at the end of the manual.

An **OVERVIEW OF THE PROGRAM** clearly outlines pre-trip preparation that will ensure a successful experience. The overview also lists general equipment to take on the trip. The choice of a study plot and the laying out of the study area are also discussed in detail.

In each of the four **ACTIVITY SECTIONS (LIVE TREES, SNAGS, DOWNED WOODY DEBRIS AND REGENERATION)** additional background information is presented. This information will help students understand the reasons for collecting specific data during each activity. The specific equipment required to complete each activity is listed in each section. There are also data sheets provided in each section for recording and mapping the data collected. At the end of each activity summary questions are provided. These questions should be read before leaving the study plot but can be answered back in the classroom to act as a follow-up analysis of the data collected.

The Canadian Nature Federation (CNF) and Ancient Forest Exploration and Research (AFER) are also producing a companion publication, **Ontario's Old Growth - A Learner's Handbook**, which will contain more detailed information about old growth forests. To obtain a copy of this publication or to enquire about CNF memberships call:

1-800-267-4088 (Canadian Nature Federation)

BACKGROUND INFORMATION

DEFINITION OF OLD GROWTH FORESTS - WHAT ARE THEY?

It is important to know that defining what is or isn't an old growth forest is not a simple task. There are many different forest types found across Ontario and each demands a specific set of criteria to define the old growth forest stage for that particular forest type. Generally the term 'old growth forest' applies to a forest that is relatively old and relatively undisturbed.

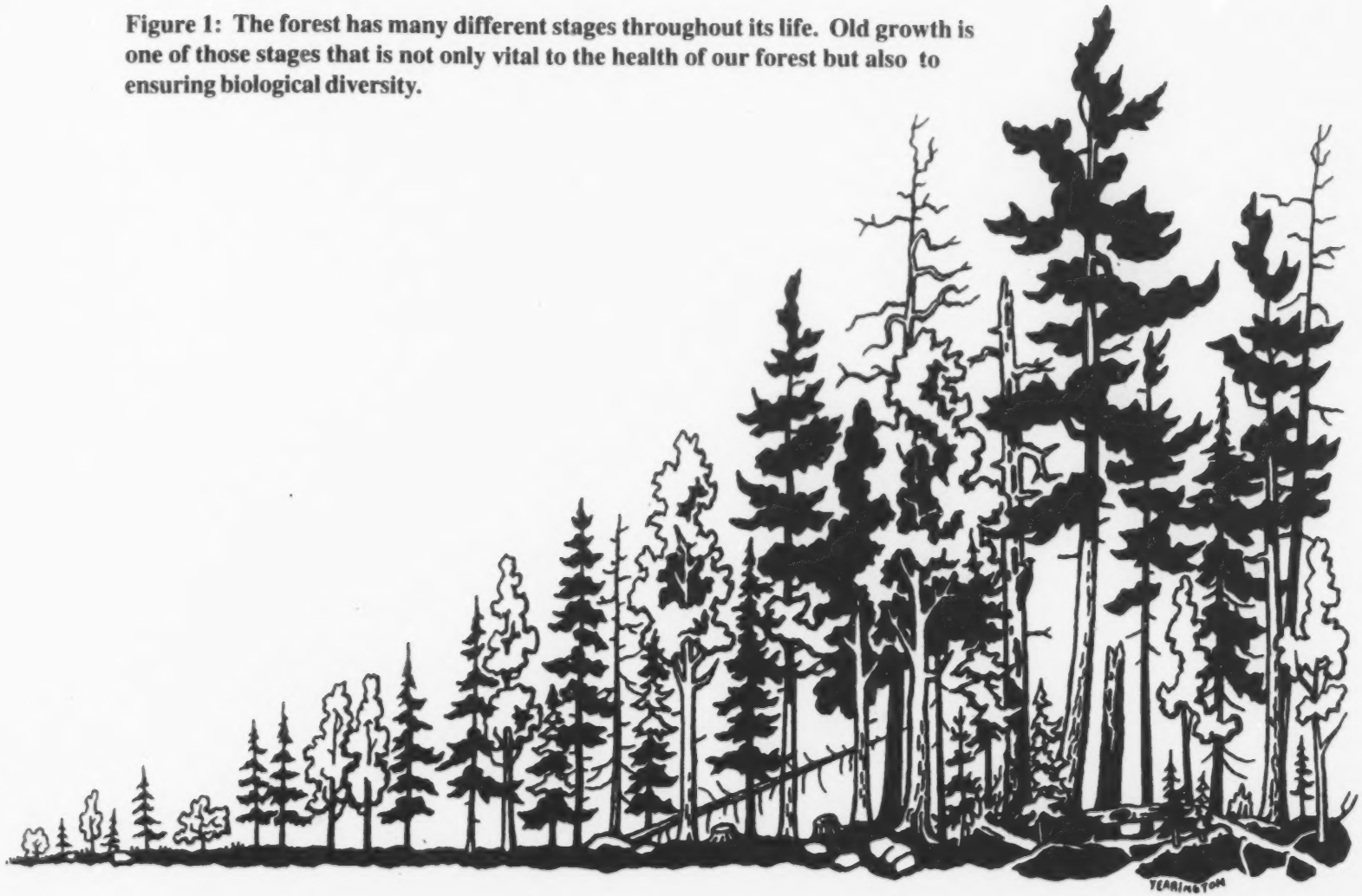
The following are some of the characteristics that distinguish old growth forests from younger forests and managed forests:

Old growth forests	Younger/Managed forests
Large and/or old trees	Smaller and younger trees
Canopy has many layers	Canopy has few layers
Large gaps in canopy	Small gaps in canopy
Few signs of logging	Recent signs of logging
More large dead or broken trees	Few large dead or broken trees
Trees with few branches to canopy	Tree branches along trunk
Logs and woody debris common	Logs and woody debris uncommon
Fallen trees create pits/mounds on the forest floor	Few pits/mounds on the forest floor
High habitat diversity	Lower habitat diversity

These general characteristics are found in old growth forests, but not all old forests possess all of these characteristics. Variations in site conditions such as climate, topography, and geology can greatly affect the character of old growth forests. An exact definition is difficult to provide. Forests, like other ecosystems, are dynamic and in a state of constant change. There are different stages in the life of a forest from young to mature to old growth forest (Figure 1). In some old growth forests there is a blend of standing dead trees, old trees, mature trees and young trees growing in the gaps provided by a tree that has fallen to become a downed log..

It is important to remember that, just as with any living organism, there is diversity among old growth forests. Both the ancient stunted cedars clinging to the rim of the Niagara Escarpment and the large impressive pines found in the Temagami area can be classified as old growth.

Figure 1: The forest has many different stages throughout its life. Old growth is one of those stages that is not only vital to the health of our forest but also to ensuring biological diversity.



OLD GROWTH FOREST VALUES - WHY SAVE THEM?

In addition to the obvious short-term economic benefit gained from logging, old growth forests are valuable for many equally important reasons:

1) To maintain biodiversity.
2) For their aesthetic and spiritual values.
3) As a genetic pool.
4) To provide diverse habitats for wildlife.
5) As a baseline for scientific research.
6) To help prevent soil erosion.
7) To store carbon in dead wood (thereby helping to reduce the effects of global warming).
8) To recycle nutrients efficiently.
9) To assist in purifying water.

Today very few old growth forests remain in central and southern Ontario. The vast red and white pine forests that once covered most of southern Ontario have been reduced to a few scattered fragments. In fact only ten percent of the original Carolinian forest, a biologically diverse area of the southwestern tip of Ontario, remains forested and almost none of this remnant is old growth.

If we are to benefit from the values provided by old growth forests then it is essential that we start to preserve some of what remains.

OLD GROWTH FOREST ECOLOGY - HOW THEY WORK!

Forests are dynamic living systems that grow and evolve, all the while experiencing the influence of many environmental factors. Water, light and fire are three of the major environmental influences that can determine the nature of old growth forests.

Water

Water is an essential resource that plants (including forest trees) require to grow and reproduce. Water is used to bring nutrients into the plant through the roots, transport materials within the plant, make food during the process of photosynthesis and cool the plant.

The amount of water in the soil has a critical influence on the plants of any forest. It determines the type of plants which are able to grow in a certain site, their size, the rate of growth and the ability of the plants to survive to reproduce. The state of the forest in return can have a direct effect on the amount of water that is capable of being retained in the soil.

Water retention is normally higher in old growth forests due to the build up of logs (downed woody debris) on the forest floor. When logs are well decomposed they act as sponges, soaking up and retaining water. During wet periods of the year, water is absorbed and then slowly released during

drier conditions. As a result these moist downed logs provide a valuable oasis to many animal species and provide an ideal growing environment for the seedlings of many plant species.

Light

Plants need light throughout all stages of their lives to photosynthesize, to grow and eventually to reproduce. The amount of light available to a plant and the distribution of the light in the forest have important impacts and can determine the kinds of trees that grow in the environment. For example, young white pine trees need much more light to grow than young sugar maple seedlings that tolerate shady conditions. The amount of light reaching the forest floor also determines the species of non-woody understorey plants, such as wildflowers, that can survive.

In what we think of as a typical old growth forest, some of the larger trees routinely fall over opening up the forest canopy. Every time a tree falls a gap is produced through which sunlight can reach the forest floor. The increased light becomes available to young seedlings and provides them with the energy they require to grow more quickly into larger trees. This type of old growth forest can be seen as a series of gaps always renewing the forest with new trees. In an undisturbed area the result is a forest with a diversity of trees of different ages, some young, some mature, some old, some dead and standing, and some as fallen logs. All of this diversity means that a diverse group of animals can survive in this old growth forest type.

Fire

Fire is an important and in some cases an essential component of some types old growth forests. It is particularly critical to the regeneration of oak, hemlock, red pine and white pine forests in central Ontario. In these old growth forest types, most fires do not destroy the entire forest. They burn off most of the understorey plants and some of the taller trees. Living trees left behind by the fire serve as a seed source to produce the new forest.

The leaf litter on the forest floor is also burned off, exposing the mineral soil beneath it. The early growth of some tree species such as red and white pine need the exposed mineral soil and the increased light levels for the germination of seedlings. Since wildfires have been suppressed in central Ontario, starting in the early 1920's, natural forest regeneration has been altered. As a result, very little red pine forest has been regenerating naturally.

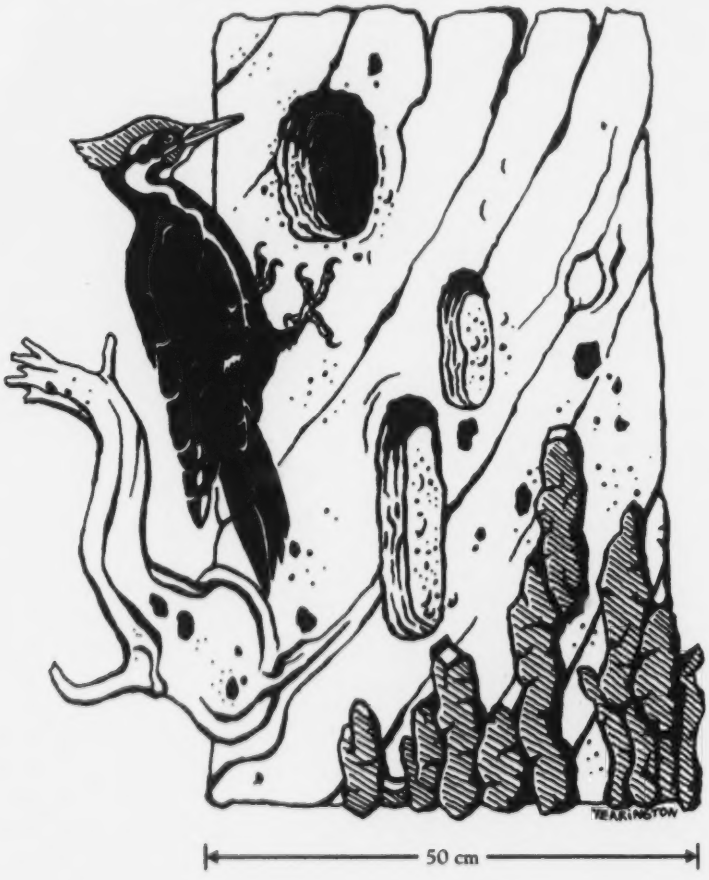
OLD GROWTH FOREST INHABITANTS - WHO LIVES THERE?

Some species of wildlife are adapted to a young forest while others require old forests for shelter or food. Other species, like moose and deer, seek out the plant growth of a young forest for food but need more mature forests for winter shelter.

As a forest ages, the plant species on the ground change as do the trees. The structure of the forest changes with time and the habitats become more complex. Available food sources also change as the forest ages. An old growth forest provides the greatest diversity of food sources for wildlife. Species that prefer older forests are the Pileated Woodpecker (Figure 2), the marten (Figure 3) and the woodland caribou.

The Pileated Woodpecker requires large standing dead trees (snags) to excavate their nesting cavities. The cavities can later be inhabited by other animals that favour old-growth, such as the flying squirrel. The Pileated Woodpecker is a species that also requires a large area of forest, between 70 and 200 hectares. In these large areas the birds are an important natural control of insects, often excavating feeding cavities in both live and dead trees.

Figure 2: The Pileated Woodpecker is one of the birds that needs old growth forests, especially large standing dead trees to produce nesting cavities.



The marten is a member of the weasel family that depends on old growth forests. They need large cavity trees, most commonly found in old growth forests, to use as dens. Marten also require large remote areas of mature or old-growth coniferous forest as hunting and feeding territories. The average home range of a male marten is three square kilometres.

Figure 3: The American marten is a tree-climbing member of the weasel family that is found in old growth forests. They feed on rodents and are effective predators of red squirrels.

Woodland caribou use a variety of habitats. In summer caribou graze on grasses, sedges, mosses and lichens in open areas. However, in winter they depend on the lichens that are found growing on tree branches of old growth coniferous forests.

As well as the visible plants and animals, there is a world of tiny or even microscopic organisms found in old growth forests. Scientists are discovering more and more insects, lichens, and fungi which are unique to old growth forests.

Old growth forests create optimal conditions for certain wildlife and a diversity of habitats that attract a broad range of species. This distinct wildlife community is lost when old-growth forests disappear.

OVERVIEW OF THE PROGRAM

EXPLORING OLD GROWTH FORESTS is an active hands-on program designed to provide students with an opportunity to study various aspects of Ontario's forest. Specifically students will become familiar with the value of old growth forests and learn about some of the characteristics that define this stage of the forest. By studying a forest plot (anywhere in Ontario), students will learn about the components of forest ecosystems and will be able to determine if the plot studied contains any of the characteristics attributed to old growth forests. The scarcity of old growth forests and the need to protect some of the remnants will be another of the valuable conclusions the students will arrive at as a result of completing the following activities.

The program has been divided into four field activities which cover four key elements in forest ecology; live trees, standing dead trees (snags), logs (downed woody debris) and regeneration. Each section contains:

i) a list of equipment needed,
ii) a description of field activities,
iii) data sheets,
iv) follow-up summary activities/questions for analysis.

The activities of all sections can be run concurrently in the same forest plot.

ORGANIZING BEFORE THE TRIP

The following suggestions are provided to help ensure that the experience is most profitable for the students. Obviously the more familiar students are with the concepts and background information of the program prior to the excursion, the more they will be able to derive from their experience in the field. As well, if the students are able to review the detailed instructions for each of the activities before the excursion, the smoother the field work will proceed.

- Review the concepts and background information provided in this manual with the students.
- Review the detailed instructions for each of the activities with the students before heading out into the field.
- Review the tree identification guide with the students using leaf/twig/bark samples from your local area.
- Demonstrate the use of a compass to the students.
- Carefully review the instructions for setting up a plot.
- Collect the equipment needed for the trip.
- Divide the students into groups of 9 or 10. Each group will work on a plot. The groups will be divided into sub-groups to work on the four different activities in the plot.
- Copy a set of four data sheets for each group of 10 students.
- Provide each group of students with the BACKGROUND INFORMATION and INSTRUCTIONS for each activity.

EQUIPMENT

The list of suggested equipment for each activity is provided in the information/instruction section for the each activity. In some cases we have suggested alternatives to purchasing equipment. Students may be able to bring some equipment from home or the school may have suitable equipment that can be used as a substitute.

The following personal articles are also suggested for a day trip:

First-aid kit
Clipboard - clear plastic cover in case of rain
Pens and pencils
Paper
Rain gear
Layered clothing for cool weather
Ample food
Drinking water
Hat and Sunscreen
Bug Repellent
Sturdy Hiking Boots
Back Pack

TREE IDENTIFICATION GUIDES

The following is a list of tree identification guides that are readily available either through your school library, the local public library, local bookstores, or on loan from local naturalists clubs or Ministry of Natural Resources offices.

Brockman, C.F. 1968. *Trees of North America*. Golden Press, New York.

Elias, T.S. 1980. *The complete trees of North America. Field guide and natural history*. Van Norstrand Reinhold, New York.

Hosie, R.C. 1979. *Native trees of Canada*.8th edn. Fitzhenry & Whiteside, Don Mills, Ontario.

Lauriault, J. 1989. *Identification guide to the trees of Canada*. Fitzhenry & Whiteside, Don Mills, Ontario.

McKay, S.M. and P.M. Catling. 1979. *Trees, shrubs and flowers to know in Ontario*. J.M. Dent & Sons, Don Mills, Ontario.

CHOOSING A SITE

The site chosen as a study area does not necessarily need to be an area that would be considered prime old growth forest. In fact because of the scarcity of old growth forest remaining in the province, most schools would be required to do a good deal of travelling to reach a plot of old growth.

It is recommended that an area of mature forest with obvious snags and downed logs be selected as the study site. One of the objectives of the activities is to become familiar with some of the characteristics of old growth. By comparing what is found in the study area with known characteristics of old growth forests, the students will be able to determine the age of the forest studied and indicate which old growth characteristics, if any, were recorded.

SETTING UP A PLOT

Each group of students can lay out the forest plot they will study. Teachers can provide the students with the instructions that follow. If equipment is limited, student groups can either work together to set up all of the study plots for the class or share equipment when one group is finished. Remember to allot sufficient time for this initial activity.

The following equipment is required for laying out the 10 metre x 10 metre study plot:

- 1 50 metre measuring tape or measured rope for each plot
- 1 or 2 compasses
- flagging tape or coloured ribbon
- 4 stakes for marking the corners of each plot

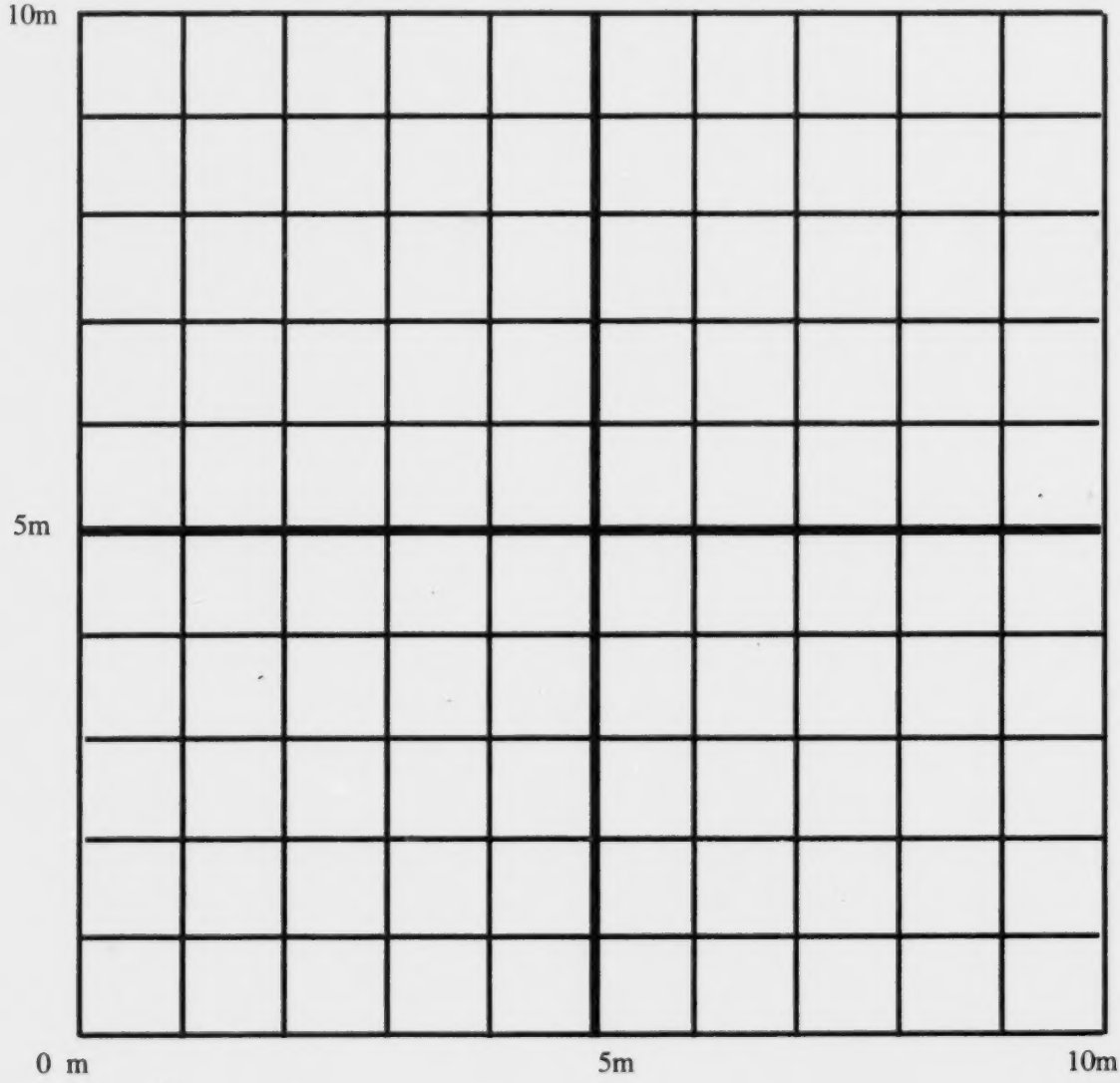
INSTRUCTIONS FOR LAYING OUT A STUDY PLOT:

1. After a study area with snags and logs has been chosen, decide which compass heading to use for the vertical axis of the plot (see the illustration of the study plot on the following page).
2. Place a stake marked with flagging tape in the ground on the spot that is to be the lower right-hand corner of the plot. Tie or tack the beginning of the 50 metre tape to this first stake.
3. To lay out the right side of the plot, one student stands at the stake at the end of the 50 metre tape. A second student takes the measuring tape and runs it along the compass heading until the 10 metre mark is reached. With the first student as a marker, use the compass to make sure that the tape is straight and on the correct heading. The second student may also use a compass to double check the accuracy of the tape.
4. At the 10 metre mark place another stake marked with flagging tape in the ground. Tie or tack the 50 metre tape to the stake.
5. The first student moves up to the second marker. Adjust the compass heading by 90 degrees so that the second side of the plot is perpendicular to the first.
6. The second student runs the tape along the new compass heading for 10 metres until the 20 metre mark on the 50 metre tape is reached. Double check the tape for accuracy and place another

stake in the corner. Tie or tack the 50 metre tape to this third stake.

7. Repeat steps 5 and 6 for the third and fourth sides. When you are finished you should have a complete square with the 50 metre measuring tape around the outside of four sides of the plot to use as a reference for mapping.
8. Use flagging tape to mark the four corners. Also at every two metres along each side of the plot tie a piece of flagging tape in a place where it can be seen easily. These markers will be used to map the trees, logs and snags. Students should lay out a line in the centre of the plot (along the original compass heading), marking every two metres and the middle of the line with flagging tape.
9. Do not forget to remove all markers and flagging tape at the end of your study of the plot.

Figure 4: The layout of the plot is the first step in the study of the area and cleaning up is the last .



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ACTIVITY #1

LIVE TREES IN OLD GROWTH FORESTS

OBJECTIVES:

In the live tree section students will have an opportunity to:

a) identify all of the trees in the plot.

b) measure and map trees to determine the species composition of the forest, the age distribution of the trees, and the productivity of the forest.

c) learn about the role of live trees in the forest environment.

d) look for signs of wildlife in the live trees, ie. cavities, claw marks, etc.

EQUIPMENT (per group of 2 students)

- 1 diameter at breast height (DBH) tape or measuring tape with centimetre markings
- tree identification guide
- 1 compass
- 1 set of live tree data sheets
- 1 tree corer (if available; check with local Ministry of Natural Resources (MNR) office or forestry company)
- drinking straws and masking tape (if corer is available)
- 1 fine-tipped waterproof marker

LIVE TREE BACKGROUND INFORMATION

Mature trees are perhaps the most important component of the forest ecosystem. The trees define the forest ecosystem and affect the light, temperature, soil and the amount of water in the forest ecosystem.

The forest canopy, the cover created by the upper branches of the mature trees, can be quite variable depending on the type of forest. The canopies of deciduous forests are well closed while the canopies of mixed or coniferous forests are more open. In a mature deciduous forest very little light penetrates the canopy to reach the forest floor. As a result the plant life found there is less abundant, especially in summer. In an old growth deciduous, mixed or coniferous forest the canopy is more open, often with gaps. More light reaches the floor and more plants can grow. The result is a multi-layered forest.

The temperature at the forest floor is also affected by the canopy cover. The canopy shades the floor making it cooler and keeps the temperature from fluctuating drastically from day to night. The lower temperatures on the forest floor also reduce the evaporation of water.

Trees greatly influence the water cycle in the forest ecosystem. The trees suck up enormous amounts of water from the soil through their root systems. The water moves through the trees and evaporates from their leaves using. This process is called evapotranspiration. It helps to cool the leaves and prevent them from getting scorched in the hot sun.

Forest soils are greatly affected by the trees. The trees provide stability and nutrients to the soil. The dense root masses of the tree hold the soil particles together and prevent them from washing away. Throughout the year trees contribute organic matter such as leaves, twigs and branches, which decompose into valuable nutrients for trees and other plants.

FIELD ACTIVITIES FOR LIVE TREES

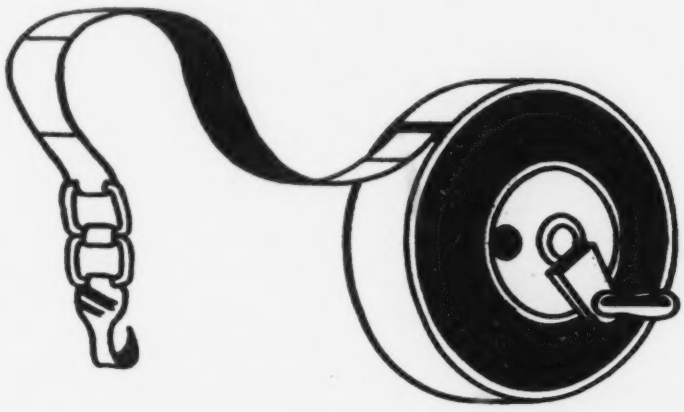
1. Diameter at breast height (DBH) is one of the most common measurements taken in forest studies. The diameter is taken at "breast height" or approximately 1.4 metres above the ground. There are two ways to measure the diameter:

   i) Use a DBH tape. A DBH tape automatically converts the circumference of the tree measured to the diameter for that tree. Simply wrap the tape around the tree at breast height and read off the diameter from the proper side of the tape. Be sure to read the correct side! Usually there is a regular measuring tape on the other side of a DBH tape.
   ii) Use a regular measuring tape to measure the circumference of the tree and then use the formula for the circumference of a circle to calculate the diameter.

   $$\text{circumference} = \Pi(\text{diameter}) \text{ or}$$

   $$\text{diameter} = \text{circumference}/\Pi$$

   The DBH should be taken for each tree over 10 centimetres DBH in the 10 metre x 10 metre plot.



DBH tape

2. a) Mark the location of the trees on a grid representing the 10 metre x 10 metre plot. Use flagging tape marked at the corners, at the centre and halfway along each side to estimate the location of the trees. Sketch the location of each tree in the plot and label the species.

   b) Map the tree crowns on the grid to study the closure of the canopy and the presence of gaps in the canopy. To map the crowns measure the distance from the trunk to the edge of the crown in four directions around the trunk of the tree. Mark these points on the grid. If you notice that the crown has an unusual shape, measure and map any additional points needed to adequately draw the crown of the tree.

3. Identify the species of all of the trees over 10 centimetres diameter at breast height (DBH). Use the identification guide provided or other resources.

4. Estimate the height of each tree over 10 centimetres DBH using the method outlined below (see diagram on the following page):

   a) Student A stands at the base of the tree to be measured. Student B paces off a distance from the tree slightly greater than the estimated height of the tree. Student B holds a pencil at arm's length and lines up the top of the pencil Student A's head.

   b) Student B then moves their thumb down the length of the pencil from the top until it lines up with Student A's feet.
   Using the height of Student A, as measured along the length of the pencil, Student B moves the measured pencil length up the height of the tree.

   c) Student B counts the number of times the pencil length is moved upwards until reaching the point of sudden branching (for deciduous trees), or a diameter of approximately 10 centimetres (for evergreen trees).

   d) To calculate the height of the tree multiply the number of times the measured pencil length was moved up by the actual height of Student A.

Figure 5: Estimating the height of a tree is made easy using the proportional method illustrated below.

Optional Activity (if a tree corer is available)

5. A tree core will provide an accurate estimate of the age of the tree. One tree core can be taken in each plot. The largest tree in the plot should be cored. Indicate on the tree data sheet which tree in the plot was cored.

   Method for tree coring:

   a) Remove the spatula from the corer, being careful not to damage it.

   b) Place the corer perpendicular to the tree at breast height and point it towards the centre of the tree. Gently apply pressure and twist the corer. You may have to push fairly hard to pierce the bark.

   c) Once the corer is lodged in the tree trunk you will have to turn the handle and apply just a little pressure. Hardwoods such as sugar maple and oak will require a little more effort.

   d) Turn the handle until the corer has reached the centre of the tree (you only need to extract one half of the tree to get a sample of all the growth rings). Place the spatula against the tree to estimate how far the corer has gone into the tree.

   e) Once the corer has reached the centre of the tree slide the spatula into the corer. You will have to apply a little pressure to get it to go under the sample inside. BE VERY CAREFUL NOT TO BEND THE SPATULA. After the spatula has been pushed all the way into the corer turn the handle BACKWARDS one quarter turn to break off the sample. Twist forward one quarter turn again to the original position then gently pull out the spatula. It will take a little tug to get it started. Be careful not to pull it out too quickly because the sample may fall off the spatula.

   f) Put the sample in a plastic drinking straw and seal both ends with masking tape. Use a waterproof marker to label the ends properly (to indicate which is the bark end and which is from the centre of the tree). If more than one straw is needed break the sample in two pieces and make sure that all four ends are labelled properly. (Store the core in a freezer to prevent mould growth.)

LIVE TREE DATA SHEET A

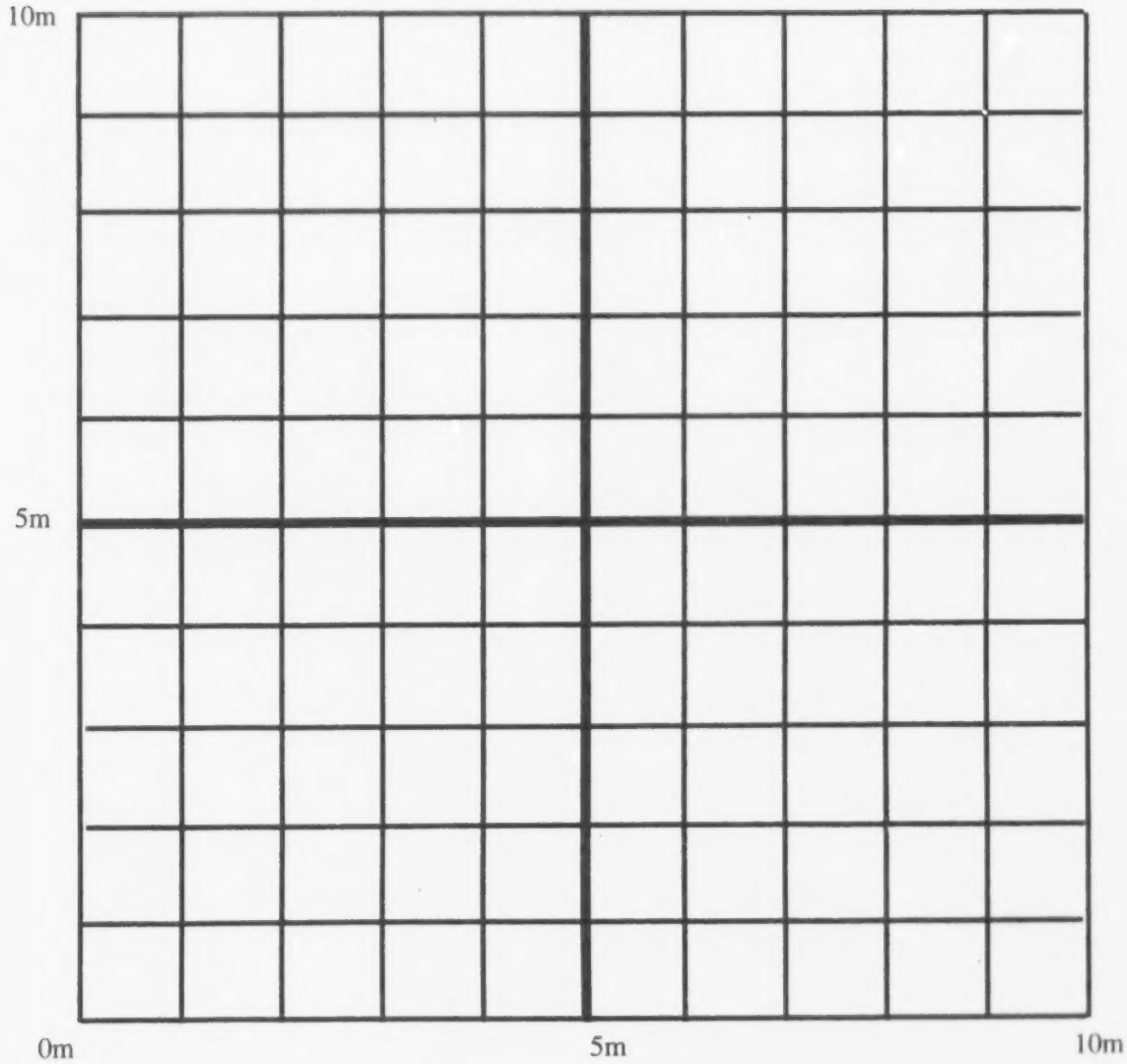
Name: _____ **Date:** _____
Plot #: _____ **Plot Location:**

Tree #	Species	DBH (cm)	Height
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

LIVE TREE DATA SHEET B

Name: _____ **Date:**

Plot #: _____ **Plot Location:**



LIVE TREE SUMMARY QUESTIONS

What can the information collected tell us about the forest that we are studying?

1. Species Diversity and Abundance

List the number of trees for each species. Or produce a graph or pie chart. Is there one species of tree that is most abundant or are there many different species?

*** Photocopy the grid with the sketch of the live trees onto a clear overhead. The overhead will be laid on top of overheads from each activity section to produce a complete picture of the plot and its components.**

How are the trees distributed in the plot? clumped? random? regularly spaced?

2. Age/Size Distribution

The diameter at breast height (DBH) of the tree can be used to show the relative age distribution of trees within the plot. Trees with a larger DBH will usually be older than those with a smaller DBH.

Classify the trees into different size categories, 10 - 20 cm, 20 - 30 cm etc. Each category will represent a different age. This can be done for all of the trees as a whole or it can be done separately for each species.

Is the plot even-aged (all of the trees are roughly the same age) or is it uneven-aged (trees are of different ages)?

Are all the old trees one species or are they all different species? Are the younger trees the same species as the older trees?

What does this tell us about the future of the forest?

Optional Activity: Tree Coring

One year of growth is represented by a light ring and a dark ring. The light ring forms in the spring when the cells begin to grow rapidly and the dark ring forms in the later part of the growing season. Use a dissecting microscope to count the rings from the centre of the tree to the bark layer to get an estimate of the age of the tree. Now that you know the age and the DBH of the tree you can compare it to the other trees in the plot to get an idea of their ages.

3. **Site Productivity**

The DBH can be used to calculate the **basal area** of the tree. The basal area is the cross-sectional area of the tree trunk at breast height. It is commonly used as an index of the live wood present in the forest.

The basal area can be calculated using the formula for the area of a circle:

$A = \Pi r^2$ or

Basal Area = $\Pi(DBH/2)^2$

The basal areas for all of the trees are summed to get the total basal area for the plot. Plots with high basal areas have high site productivity, while those with low basal areas have relatively low site productivity.

A more accurate estimate of the volume of wood in the plot can be calculated by using the DBH and the height of the tree. Using the formula for a cylinder calculate the volume of each tree.

Basal Area x height of tree = volume of wood

ACTIVITY #2

DEAD STANDING TREES (SNAGS) IN OLD GROWTH FORESTS

OBJECTIVES:

In the snag section, students will have an opportunity to:

a) identify, measure and map snags in a forest plot.

b) learn a snag classification system and use it to classify the snags in the plot.

c) search for and identify signs of wildlife use of snags

d) learn about the importance of snags in old growth and other forests

EQUIPMENT (per group of 2 students)

- 1 diameter at breast height (DBH) tape or measuring tape with centimetre markings
- 1 pair of binoculars
- 1 tree identification guide
- 1 snag classification key
- 1 compass
- 1 set of snag data sheets

SNAG BACKGROUND INFORMATION

A dead standing tree is called a snag, chicot (pronounced cheeko), or wildlife tree. The last name is perhaps the best description of what a tree becomes when it dies. To some people dead trees are viewed as a sign of an unhealthy forest but the truth is that snags are extremely important for all kinds of wildlife from tiny insects to the bald eagle.

In old growth forests there is a greater number of large snags than in younger forests. The diversity of the snags is also greater in old growth forests.

Importance of snags

To support healthy wildlife populations the forest must have an abundance of snags. According to the Ontario Ministry of Natural Resources, six large snags per hectare are needed to support wildlife populations. The type of snags that are present in the forest is also important to wildlife populations.

Great blue herons, eagles and osprey are all known to nest at the tops of snags or in the dead tops of trees such as white pine. Some of these nests can be used for many years by these birds. Dead branches are prime perching sites for birds. Flycatchers, kingfishers, hawks, eagles and other birds hunt from these sites.
A dead tree is also used by less conspicuous organisms. Fungi, lichens and bacteria quickly take up residence in the tree after it dies and gradually break down the tree trunk. Without these organisms the tree would not decompose. Insects will also invade the tree after it dies. Termites, carpenter ants and other insects chew away at the wood of the tree accelerating the decomposition of the tree. The nests of insects within the snags become food for woodpeckers and other excavating birds.

Bats are known to roost under the loosening bark. This stage in the decay cycle of the tree also produces the nest site of a bird called the brown creeper. The cavities excavated in snags by woodpeckers are extremely important to a number of animals.

Identification and classification of snags

After they die, trees decay in a predictable pattern. At each stage of decay they provide habitat for different kinds of wildlife. There are slight differences between coniferous and deciduous trees. The identification guide on the following pages can be used to group snags into different decay categories.

Different species of birds and mammals use snags of different decay classes. For instance the bald eagle needs snags of decay class 1 or 2 to provide large branches to perch on and to support the weight of their huge nests. On the other hand the downy woodpecker needs snags of decay class 4 or greater to build their nests in because they are not strong enough to peck away at the wood of snags of lower decay classes. The species of tree may also influence the species that use them. Deciduous snags decay much faster than coniferous snags, which means that they can be used by wildlife earlier. However, because they decay quicker they may not be suitable for birds such as the bald eagle that returns to and renovates the same nest every year.

Figure 6: Snags can be classified according to the stage of decay of the dead standing tree. Each decay class is important for a variety of wildlife.

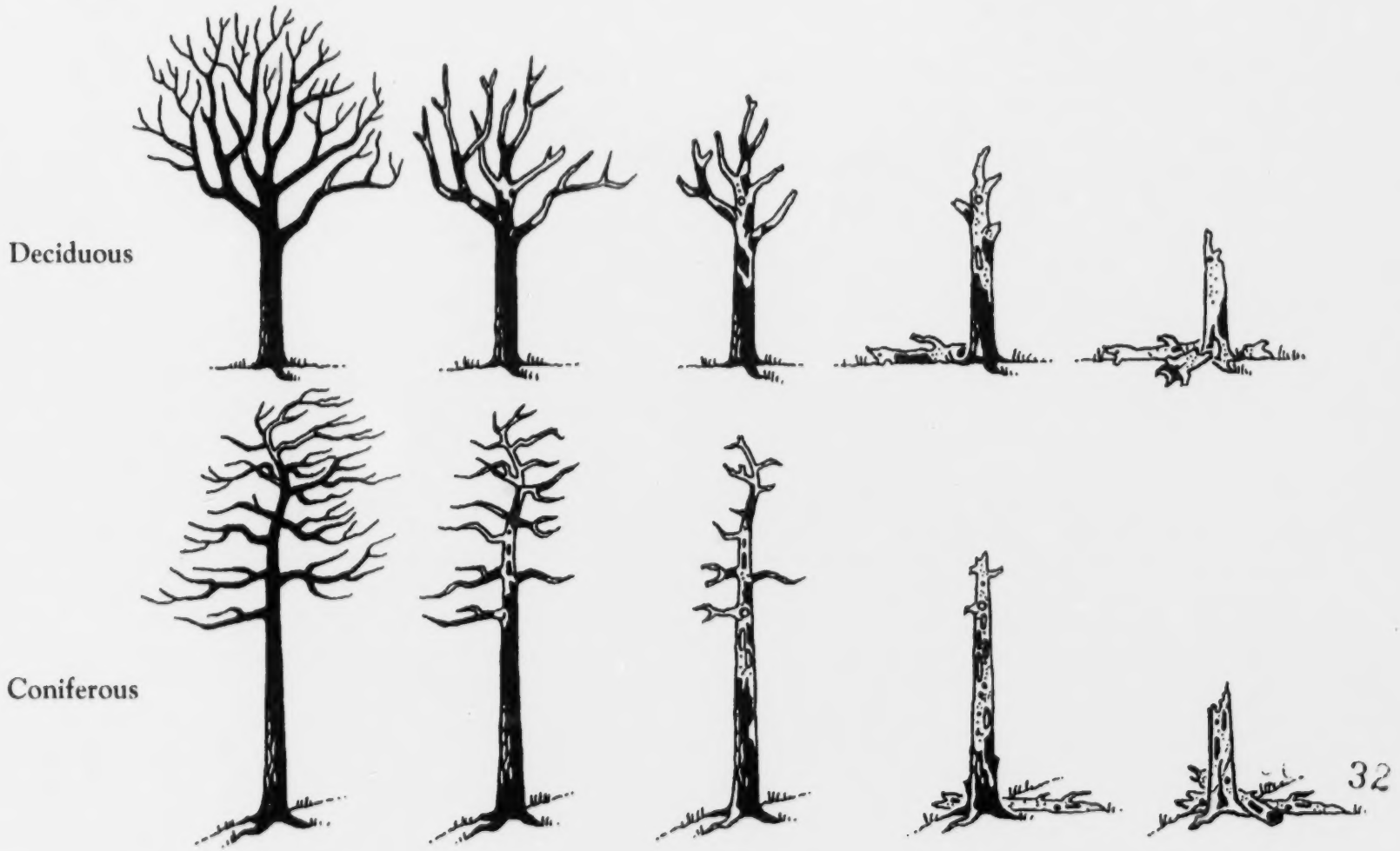


Table 1: Snag Decay Class Identification Key

Field Sign	Live tree with dead and dying branches or broken top	Decay Class 1	Decay Class 2	Decay Class 3	Decay Class 4	Decay Class 5
Tree Top	Broken top or dead stub on tree top	Tree top intact and just recently dead	Tree top intact	Tree top intact	Top broken off	Top broken to a stub, less than 6 m high
Branches	Many or most branches still alive. About 25% of canopy dead	Recently dead Fine branches still present	Fine branches gone Less than half of large branches gone	More than half of large branches gone	All large branches gone	All large branches gone
Bark	Bark on trunk intact Bark on branches may be dead	Bark mostly intact	Bark loosening	Bark usually falling off	Bark nearly gone	Bark and wood deteriorating
Cavity Nesters	Dead sections may be used by cavity nesters Yellow-bellied Sapsucker may already be nesting in tree Dead parts of tree used as drumming and display sites for woodpeckers Pileated Woodpecker can excavate these living trees	Same as live tree with dead top. Pileated Woodpecker can use this tree	Used for nesting and foraging sites for strong excavators like Pileated Woodpecker	Nesting site for weaker excavators like Downy and Hairy Woodpecker	Used by weaker excavators like the Downy Woodpecker for nesting sites and then by cavity nesters like flying squirrels	Used by weak excavators like chickadees as well as mice and chipmunks for nesting sites
Wildlife Use	Waterfront nesting sites for osprey, eagles and herons. Tree top perching and hunting sites for sites for hawks, owls and perching birds. Dead branches are common perching sites for birds such as Eastern Phoebe, flycatchers and hummingbirds. Used by herons, raptors and perching birds. Brown Creepers nest and bats roost under loose bark.					

Cavities in snags

Tree cavities in both dead and live trees are choice homes for wildlife. Woodpeckers hollow out homes in dead trees and rotten portions of live trees. Smaller birds such as nuthatches and chickadees also do a bit of digging. Natural decay around broken branches or rotting wounds also forms some cavities worth inhabiting.

The number and variety of cavity trees is one important element of old growth forests. A tree cavity provides shelter from wind, rain or snow and is a safe environment for incubating eggs or raising young. Ducks, flycatchers, warblers, wrens, thrushes, falcons, owls, mice, squirrels and even members of the weasel family such as marten use cavities for nesting, resting, food storage and raising of young.

All cavity trees are not created equal; the larger the tree, the greater the variety of species that could eventually nest in the tree. The Pileated Woodpecker, Canada's largest cavity carpenter, regularly nests in trees with a diameter of 50 centimetres or greater. They would not use a 20 centimetre diameter stub that would more likely be inhabited by a Black-capped Chickadee. Sapsuckers often nest in live trees with rotten cores, while downy woodpeckers tend to use dead trees.

Surrounding habitat is also important. A dead tree near the edge of a water body may be used by a Wood Duck. A similar tree deeper in the forest may be used by a northern flying squirrel. Place the same tree in a forest opening or clearing and it may attract a bluebird or flicker.

Tree cavities are not used just as nest or den sites. Woodpeckers often excavate separate roosting holes in which to spend the winter. Feeding cavities are dug by woodpeckers in search of beetles, ants, and insect larvae. Pileated Woodpeckers create deep rectangular cavities. Other woodpeckers make irregular holes. Flying squirrels may use holes as food caches, retreats from predators or inclement weather, and even as private outhouses.

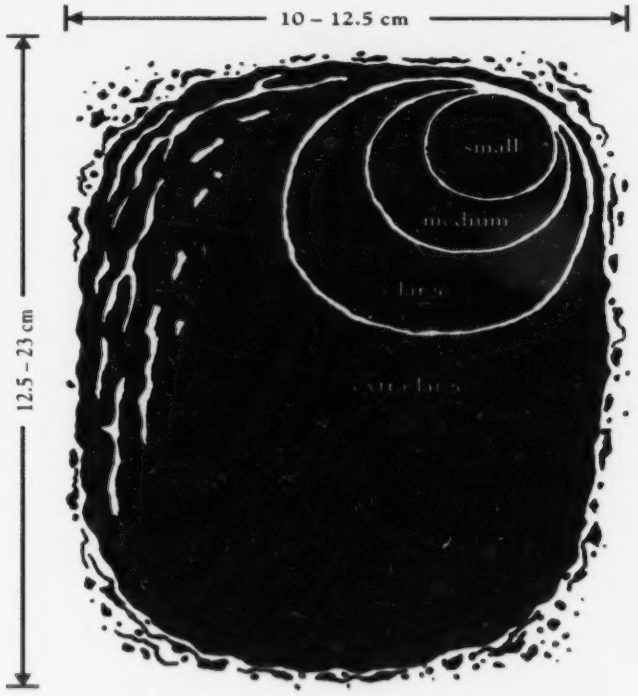


Table 2: Characteristics of tree cavities

This guide is a rough breakdown of some of the birds and mammals that make and use tree cavities in forests in eastern Canada. Don't be too surprised if you find wildlife in cavities that do not conform to this summary. Nature is full of variety.
Note that larger holes are potential homes for more wildlife species than smaller holes. In general, animals tend to use holes similar to their body size, possibly a result of competition for cavities as nest or den sites.

Cavity Size	Cavity Details and Dwellers
Small	•2.5-5.5cm diameter hole •size of a two-dollar coin to the size of a raquetball excavated by Downy Woodpeckers, Yellow-bellied Sapsuckers, Hairy Woodpecker, Black-capped Chickadee, Boreal Chickadee and Red-breasted Nuthatch •small holes can be used by Tree Swallow, White-breasted Nuthatch, House Wren, Carolina Wren, Eastern Bluebird, European Starling and Prothonotary Warbler •small dens for deer mouse, eastern chipmunk, red squirrel, northern flying squirrel and southern flying squirrel
Medium	•5.5-10 cm diameter hole •size of a hardball to the size of a grapefruit •excavated by Northern Flicker, Red-headed Woodpecker, Red-bellied Woodpecker, Black-backed Woodpecker and Three-toed Woodpecker •medium-sized holes can be used by all small hole-nesters (above), plus Wood Duck, Screech Owl, Boreal Owl, Saw-whet Owl, American Kestrel •dens for all mammals above, plus grey squirrel
Large	•10-12.5 cm wide and 12-20 cm high •size of paperback novel with rounded edges •excavated by Pileated Woodpecker •large holes can be used by all hole-nesters above, plus Common Goldeneye, Bufflehead, Hooded Merganser, Barred Owl •dens for larger mammals such as grey squirrel, raccoon, American marten
Extra Large	•round or irregular hole larger than 15 cm wide •size of volleyball or larger •usually created by decay rather than woodpeckers •tend to be roost sites and escape cavities rather than nests

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FIELD ACTIVITIES FOR SNAGS

1. Use your tree identification guide or other resources to look for characteristics of the live tree. Do not get discouraged: identification of snags can be a difficult task if the tree is well decayed. If you cannot identify the species, try to narrow it down to either coniferous or deciduous species. If all else fails list it as an unknown snag species. All snags with a diameter at breast height (DBH) of at least 10 centimetres should be identified within the 10 metre x 10 metre plot.

2. Use the Identification Key and the illustrations provided to identify the decay class of each snag in the plot.

3. Measure the DBH of each snag in the plot.

4. Estimate the height of the snag using the method outlined in the live tree field activities.

5. Mark the location of all of the snags on a grid representing the 10 metre x 10 metre plot. Use flagging tape marked at the corners, at the centre and halfway along each side to estimate the location of the snags. Sketch the location of each snag in the plot and label the species. Make sure that the grid orientation is the same as that used to map the live tree.

6. Look for signs of wildlife activity, such as insect galleries, woodpecker feeding cavities etc., on the snag and record everything you see.

   Binoculars may be used to observe cavities that are located high above the ground.

   Count the number of cavities on the snag. Try to estimate the size and shape of the cavities. Use the tree cavity illustrations to determine what made the holes and what they were used for.

WARNING!! BE EXTREMELY CAREFUL AROUND SNAGS. Some may be very unstable and can fall down with only a gentle nudge. Never lean on them or use them for balance when climbing up or down hills.

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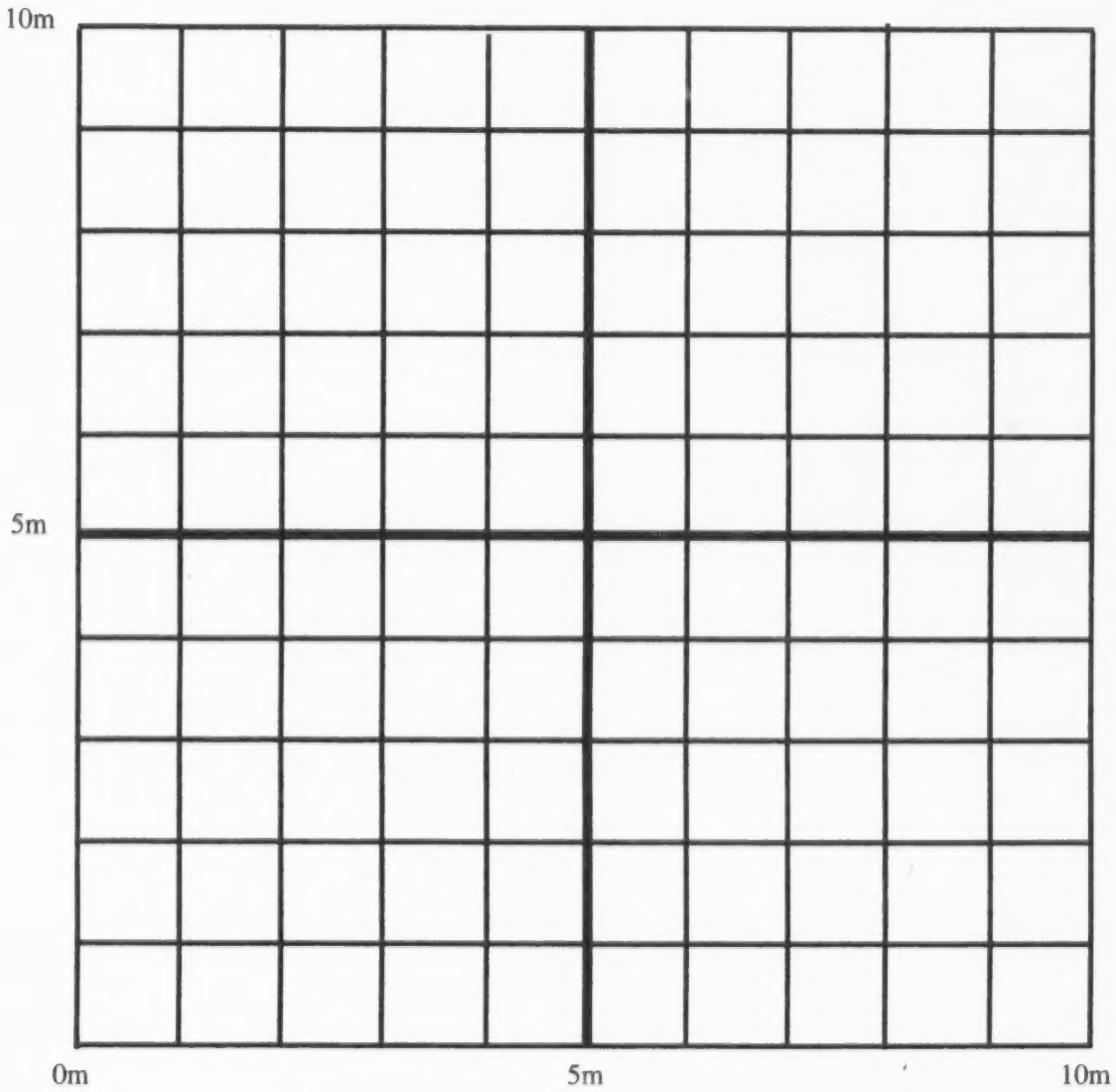
SNAG DATA SHEET A

Name: _____ **Date:**

Plot #: _____ **Plot Location:**



SNAG DATA SHEET B

Name: _____ **Date:**

Plot #: _____ **Plot Location:**

Snag #	Species	DBH (cm)	Decay Class	Height (m)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				

SNAG DATA SHEET C

Name: _____ **Date:**

Plot #: _____ **Plot Location:**

	Nesting Cavities							
Snag #	Small	Medium	Large	Number of Feeding Cavities	Number of Escape Cavities	Stick Nests	Insect Excavations	Other
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

SNAG SUMMARY QUESTIONS

1. **Species Diversity and Abundance**
Snags are not usually found in high numbers, even in an old growth forest, so you may find only one or two in each plot.

How many snags are there?

What species are they? Are they the same species as the living trees?

*** Photocopy the grid with the sketch of the snags onto a clear overhead. The overhead will be laid on top of overheads from each activity section to produce a complete picture of the plot and its components.**

2. **Snag Class Diversity**
The diversity of the snags that are present will give us an indication of how suitable the forest is for wildlife that rely on snags for foraging, nesting and shelter.

Were the snags different sizes or were they all the same size? Were there any snags greater than 50 centimetres DBH? What would this tell us about the types of wildlife that could use the snags? What does size of the snags tell us about the forest of the past?

Was there a variety of decay classes or were they all the same?

3. **Wildlife Activity**
Did you find any evidence of wildlife on the snags? Do you think that a variety of wildlife could use the snags that you found? Would a Pileated Woodpecker find enough food and a tree big enough to build a home in this forest?

What kind of cavities did you find? Were the cavities different sizes and shapes or were they all the same? What do you think created the cavities?

4. **Basal Area of Snags**

The DBH can be used to calculate the **basal area** of the snags. The basal area is the cross-sectional area of the tree trunk at breast height. It is commonly used as an index of the wood present in the forest.

The basal area can be calculated using the formula for the area of a circle:

$A = \Pi r^2$ or

Basal Area = Π $(DBH/2)^2$

The basal areas for all of the snags are summed to get the total basal area for the plot. Plots with high basal areas normally have a high use by wildlife, while those with low basal areas have relatively lower use by wildlife. Compare your results with the data available for old growth forests.

ACTIVITY #3

LOGS (DOWNED WOODY DEBRIS) IN OLD GROWTH FORESTS

OBJECTIVES:

In the log (downed woody debris) section students will have an opportunity to:

a) identify, measure and map logs in a forest plot.

b) learn a log classification system and use it to classify the downed logs in the plot.

c) search for and identify signs of wildlife use of logs

d) learn about the importance of logs in the old growth forest

e) measure the volume of the logs to compare to the volume of the living trees and to compare with data available for old growth forests

EQUIPMENT (per group of 3 students)

- 1 20 metre or 50 metre measuring tape
- 1 tree identification guide
- 1 log decay class identification key
- 1 compass
- 1 set of log data sheets

DOWNED WOODY DEBRIS BACKGROUND INFORMATION

When the tree comes to rest as a log on the ground, whether it blew over or fell over with age, the final stage in the life cycle of the tree begins. Logs on the ground are referred to as downed woody debris. Sometimes lasting over a hundred years on the ground, this debris is home to wildlife and returns nutrients to the soil.

When a tree falls to the ground it creates an abundance of opportunities for many different organisms in the forest. Trees, shrubs and wildflowers thrive on the disturbance. Tree saplings take advantage of the light that comes through the gap in the canopy and race to replace the fallen tree. The roots of a wind-thrown tree tear up the ground, exposing mineral soil. Seedlings of many plant species including trees can use the exposed soil to get established. Animals such as winter wrens, waterthrushes, mice and chipmunks use the tangled root mass as housing.

Old growth forests often have so much downed woody debris that it can be difficult to navigate through the forest. In a managed forest, mature trees do not die; they are logged and removed. Downed woody debris is usually removed or is not allowed to develop.

Insects such as beetles invade the tree. Bark beetles chew into the sapwood while carpenter ants carve tunnels for their colonies. These insect pioneers pave the way for the next wave of immigrants: fungi, bacteria, and nematodes. Nematodes are microscopic roundworms that feed on rotting logs. Eventually the life in a log is fed upon by predators higher on the food chain such as woodpeckers and salamanders.

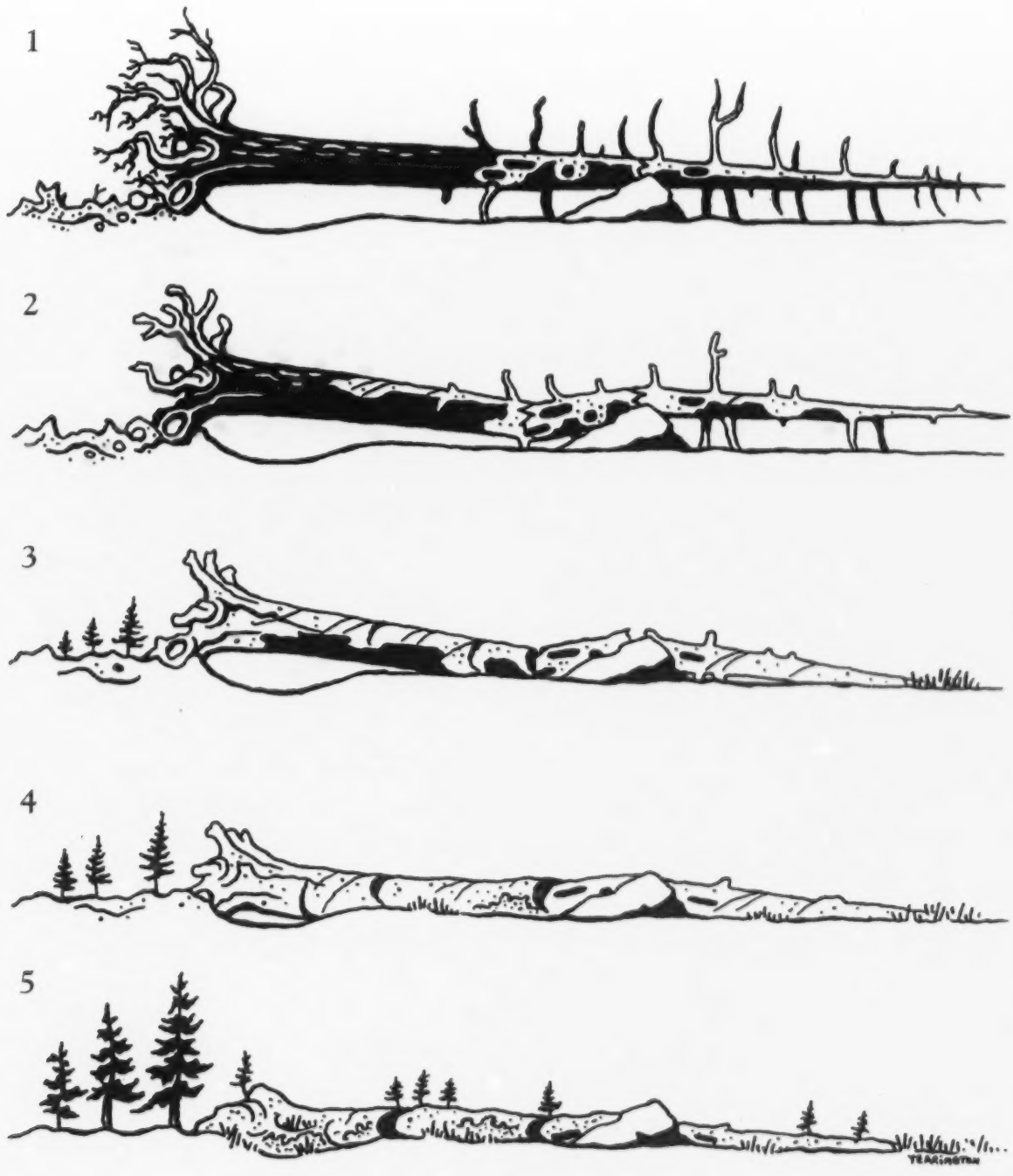
Mushrooms, mosses and lichens are log-loving plants. The log gradually soaks up water, remaining moist during dry spells. This moist environment acts as an oasis for these plants. As well some salamanders and snakes lay their eggs within logs.

The large amount of downed woody debris in streams is also a feature of old growth forests. Dead wood in streams is important as protective cover for small fish and may be sought by smallmouth bass looking for a nest site in lakes.

Looking beneath logs is a good way to start studying the importance of downed woody debris. **However, if you roll over a log to look beneath it, remember to roll it back to its original position**. Otherwise this moist habitat will dry out.

Scientists now recognize different stages of decay of logs; each stage is important to a variety of organisms. It is challenging to classify downed logs because different species decay at different rates. Pine logs may take 100 - 200 years to breakdown, while poplar logs decay much more quickly. The identification keys for logs (Figure 7 and Table 3) can be used to identify the different classes (stages) of decay .

Figure 7: Logs found on the forest floor can be classified by the stage of decay as illustrated below.



FIELD ACTIVITIES FOR LOGS

1. Identify each log that is longer than 1 metre and is a minimum of 15 centimetres in diameter. As with snag identification, this can be a challenging task. Look for clues that might indicate the species, such as bark. The stump might still be present to help identify the log.

   What clues are present to indicate why the tree fell over? Was it a snag before it fell or was it a living tree blown over by wind?

2. Use the log classification guide provided to estimate the decay class of each log in the plot.

3. Measure the length and the width at both ends of each log in the plot. The logs should be at least 1 metre long and one end of the log be at least 15 centimetres in diameter.

   (If the log crosses the plot boundary measure only the part of the log that lies within the plot.)

4. Each log measured should be sketched on a grid representing the plot. Flagging tape marked at the corners, the centre and halfway along each side of the plot can be used to estimate the location of each end of the log.

5. Look for evidence of wildlife on the logs. Carefully roll over the logs (if it is not well decayed) and look for life. Record any observations you may make, insects, salamanders, etc. (Please do not pick up the salamanders. If their skin dries in your hand, they could die!) Signs of wildlife to look for include piles of pine cone scales on top of the logs (squirrel activity), dens, and owl pellets (the regurgitated remains of its prey).

Table 3: Log Decay Class Identification Key

Looking beneath logs is a good way to start studying the ecology of downed woody debris. But be careful. If you roll a log over to look beneath it, remember to roll it back. If the log is left rolled over, the moist micro-habitat will dry out and will take quite a while to recover.

Decay Class	Form and Shape of Log	Branches	Bark	Wood Moisture/ Texture	Plant and Animal Habitat
Decay Class 1	•Tree recently fallen, form still distinct •Log round and rigid	•May be elevated by branch stubs or ground	•Bark intact	•Solid, rigid tree with dry, hard wood	•Little or no new plant growth on log
Decay Class 2	•Form still distinct •Log round •Log supports weight of person	•Branches and branch stubs mostly gone	•Bark loose but patches may still remain	•Moist wood, beginning to soften •Log somewhat rigid but sags	•Some new moss, lichen, fungal and algal growth on parts of the log •Grouse drumming and woodpecker foraging site
Decay Class 3	•Log round but sags to conform with ground contours	•No branches	•Trace of bark	•Wood breaks into large hard pieces •Log does not fully support weight of person	•Tree seedlings and flowering plants begin to grow on log •Bear foraging site (ants)
Decay Class 4	•Log rotten and covered with leaves •Log oval or flattened •All of log on ground or beneath surface of ground or leaf litter	•No branches	•No bark	•Soft and powdery wood •May not appear as log at first glance	•Nurse log for tree seedlings •Perched trees or seedlings may be only evidence of log
Decay Class 5	•Log rotten and covered with leaves •Log oval or flattened •All of log on ground or beneath surface of ground or leaf litter	•No branches	•No bark	•Soft and powdery wood •May not appear as log at first glance	•Nurse log for tree seedlings •Perched trees or seedlings may be only evidence of log •Breeding site for snakes and salamanders

LOG DATA SHEET A

Name: _____ **Date:** _____

Plot #: _____ **Plot Location:** _____

Log #	Species	Diameter(cm)	Length (m)	Decay Class
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

LOG DATA SHEET B

Name: _____ **Date:**

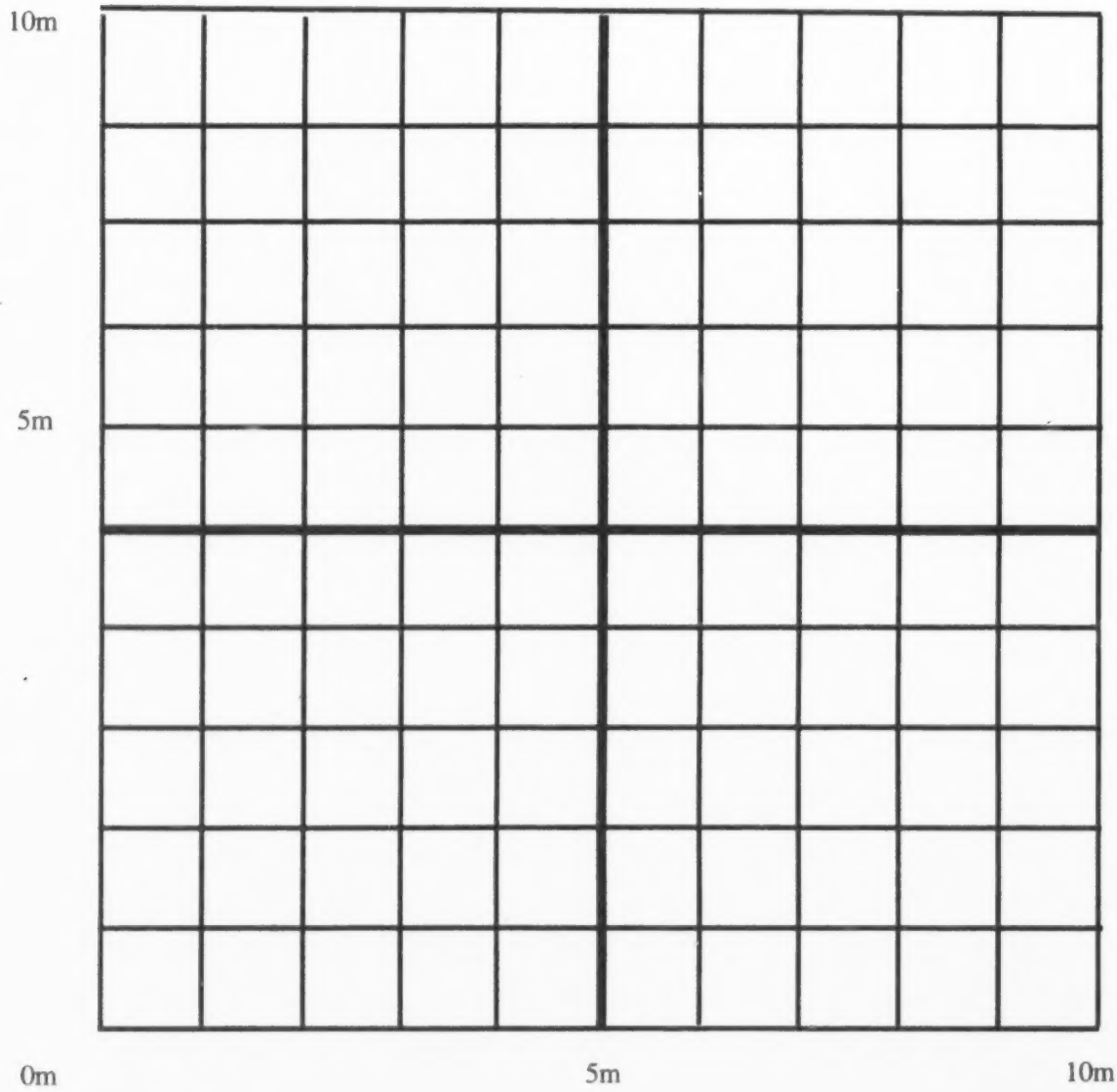
Plot #: _____ **Plot Location:**

Log #	Wildlife Observations	Plant, Fungi, and Lichen Observations
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

LOG DATA SHEET C

Name: _____ **Date:** _____

Plot #: _____ **Plot Location:** _____



LOG SUMMARY QUESTIONS

1. **Species Diversity and Abundance**
How many logs were there in the plot?
Were there more logs than trees? than snags? What does this tell us about the length of the live tree stage, snag stage and log stage?

*** Photocopy the grid with the sketch of the logs onto a clear overhead. The overhead will be laid on top of overheads from each activity section to produce a complete picture of the plot and its components.**

How many logs were identifiable? List the number of each species of log in the plot.
Are the species of logs the same as the live trees or the snags or were they different?
Did the sizes and types of trees change from live tree to snag to log?

2. **Log Decay Class Diversity**
Study the decay classes of the logs. Are they all the same decay class or are they different? If they are all the same decay class do you think they may have all died at the same time? What do you think might have killed them?

Do you think that all species decay at the same rate? Which species decayed faster than others?

3. **Evidence of Wildlife**
What kind of wildlife activity/signs did you see on the logs?

Did you find any logs that may be suitable for salamanders or snakes to lay their eggs? How damp were the logs? Were you able to squeeze any water out of the wood?

3. **Volume of Logs**
Calculate the volume of each log using the following equations.

Basal Area = Πr^2

Volume = Basal Area x length

Calculate the total volume of logs in the plot by adding together the volumes of all logs measured.
Convert to cubic metres (m^3) of downed woody debris per hectare by multiplying by 10.
Compare the volume of the logs to the volume of logs found in old growth forests.

ACTIVITY #4

YOUNG TREES (REGENERATION) IN OLD GROWTH FORESTS

OBJECTIVES:

In the young trees (regeneration) section students will have an opportunity to:

a) quantify the amount of new growth in the forest study plot.

b) learn to separate woody and non-woody plant growth.

c) learn about the importance of regeneration to forest ecosystems.

EQUIPMENT (per group of 2 students)

- 4 one metre sticks
- 1 guide to wildflowers
- 1 guide to trees
- 1 set of young tree data sheets

REGENERATION BACKGROUND INFORMATION

The kinds of young trees, their rate of growth and their survival are influenced by many factors. Certainly the species of mature trees currently found in the forest will determine which tree seeds will be available to replace the older trees. Also the soil conditions, the terrain and the moisture levels all affect the regeneration (germination and growth of young trees) in the old growth forest.

Once the tree seeds have germinated, the young saplings depend on light for their continued growth and survival. The amount of light available to a plant and the distribution of the light in the forest have important impacts and can determine the kinds of trees that grow in the environment. Young sugar maple seedlings can survive for several years at low light levels growing no more than a few centimetres every year. The amount of light reaching the forest floor also determines the species of non-woody plants that can grow.

When large trees are left uncut, eventually some of the larger trees fall over opening up the forest canopy. Every time a tree falls a gap is produced through which sunlight can reach the forest floor. The increased light becomes available to young seedlings and provides them with the energy they require to grow more quickly into larger trees. This type of old growth forest can be seen as a series of gaps always renewing the forest with new trees. In an undisturbed area the result is a forest with a variety of trees of different ages, some young, some mature, some old, some dead and standing, and some as fallen logs.

In red and white pine old growth forests of central Ontario, fire is important and in some cases essential for regeneration. In this old growth forest type, most fires do not destroy the entire forest. They burn off most of the forest floor plants and some of the taller trees. The forest is opened up and again more light can reach the forest floor. Young seedlings can take advantage of the freshly exposed mineral soil and the increased light. Living trees left behind by the fire serve as a seed source to produce the new forest.

FIELD ACTIVITIES FOR REGENERATION

1. Choose four different sites within the 10 metre x 10 metre plot to study the growth of young trees. If gaps in the canopy exist, place two of the sites below these gaps. The other two sites should be below a tree canopy that is fully closed. If no gaps exist, complete four sites randomly selected.

2. Form a square metre at the first site by laying the four metre sticks on the ground to form a box (a quadrat).

3. Count the total number of woody plants, both young trees (saplings) and shrubs, found within the square metre quadrat. If possible, try to identify the saplings with help of a tree identification guide.

4. Count the total number of non-woody plants, including wildflowers, within the square metre quadrat. If time permits, try to identify some of the more common plants with the help of a wildflower identification guide.

5. Record all information collected on the regeneration data sheets. Map the location of the four quadrats studied on the grid of the plot.

Regeneration Data Sheet A

Name: _____ **Date:** _____

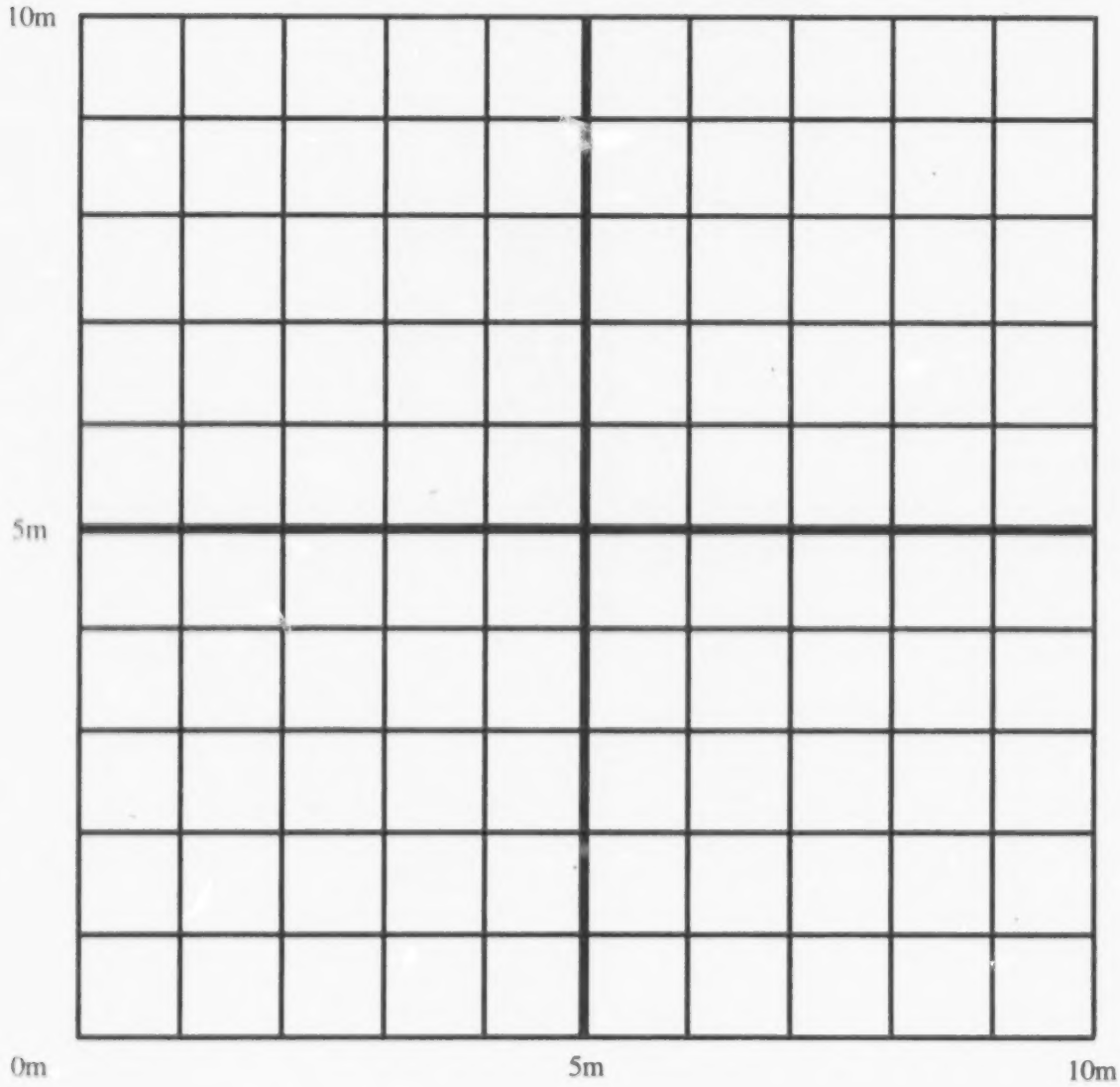
Plot #: _____ **Plot Location:** _____

Quadrat	No. of Woody Plants	Species Identified	No. of Non-Woody Plants	Species Identified
1				
2				
3				
4				

Regeneration Data Sheet B

Name: _____ **Date:** _____

Plot #: _____ **Plot Location:** _____



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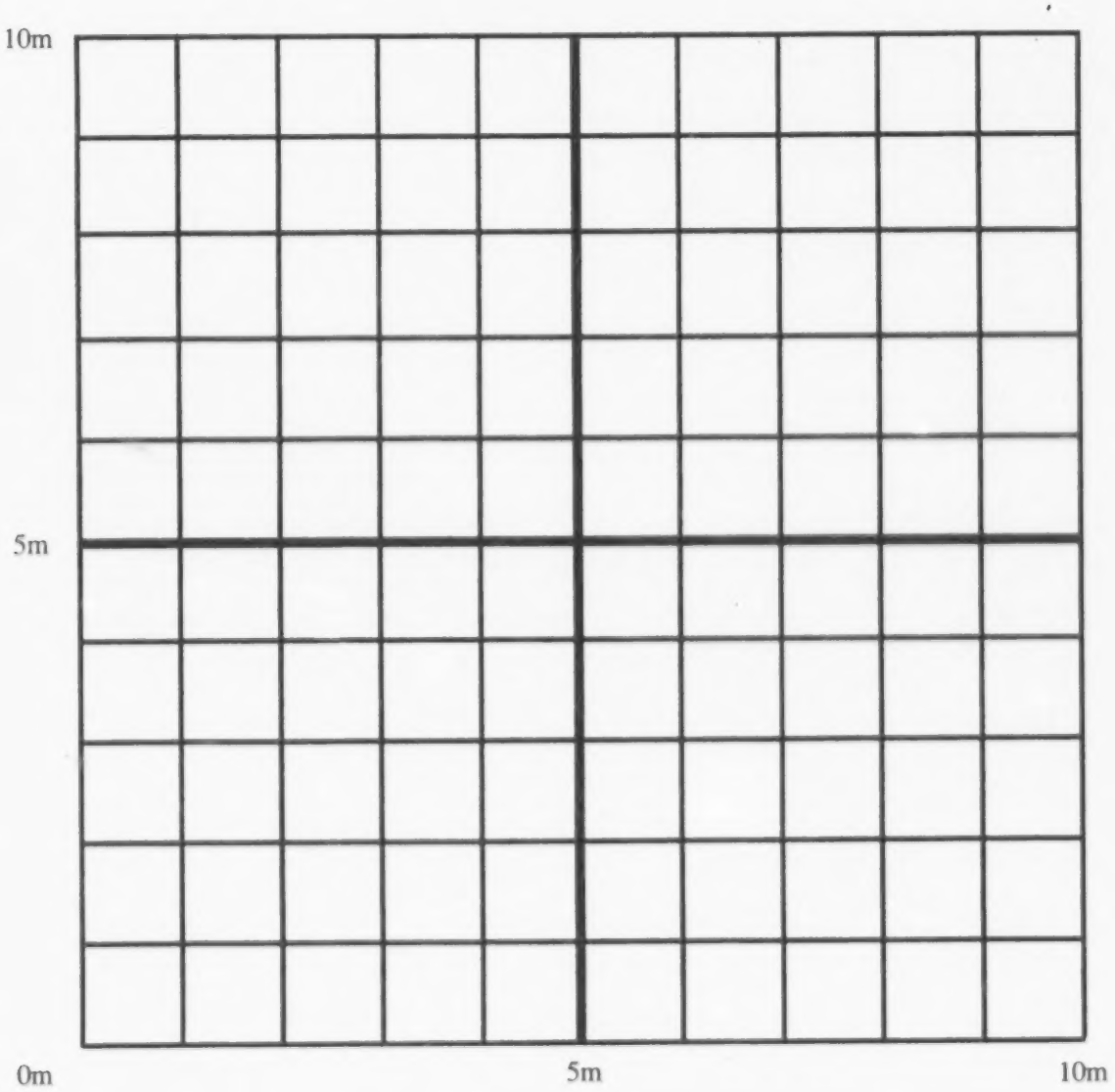
Regeneration Data Sheet B

Name: _____ **Date:** _____

Plot #: _____ **Plot Location:** _____



REGENERATION SUMMARY QUESTIONS

What do the answers to the following questions tell us about the regeneration of the study area?

1. Abundance of Regeneration

Compare the number of young trees found in the two quadrats located under the gaps with the number of young trees in the quadrats located under a closed canopy.

*** Photocopy the grid with the sketch of the regeneration quadrats onto a clear overhead. The overhead will be laid on top of overheads from each activity section to produce a complete picture of the plot and its components.**

Which quadrats contain more young saplings and woody plants? Are the heights of the young saplings the same in all plots? Is there one species of young tree that is most abundant or are there many different species?

2. Distribution

Take a look at the distribution of young saplings in the 10 metre x 10 metre plot as a whole. Is there a pattern noticeable?

How would you rate the amount of young trees growing in the plot? Are they abundant? average in amount? or scarce? How do the number of young trees in the plot compare to the number of live mature trees? to the number of snags? to the number of downed logs?

What happens if there are no gaps in the forest? What happens if we always suppress naturally caused forest fires in pine forests?

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OLD GROWTH BASELINE DATA

The following is a sampling of baseline data for both deciduous and coniferous old growth forests found in Ontario. This information can be used a basis of comparison to determine if the forest plot you studied has some of the characteristics of the average old growth forests found in the province. Remember that living organisms, forests included, do not always or easily fit into neat and discreet descriptions. Each forest will experience different forces at different stages of its development. The result is that there is a great deal of diversity between forests, as much diversity as can be found in any one old growth forest.

EASTERN DECIDUOUS FORESTS [*1]

1. These forests are usually dominated by beech, maple hemlock, oak, and birch. They located in southern and central Ontario.

2. Minimum live tree basal area - 29 m2/ha

3. Minimum mass of downed woody debris for old growth - 20Mg/ha
In an old growth forest the downed woody devris should also be alrge and vary in age and decay class.

4. Minimum number of large snags (greater than 50 cm DBH) - 4 large snags/10 ha

5. Old growth deciduous forest normally have some of the following spring non-woody plants:

Foam flower - *Tiarella cordifolia*
Toothwort - *Dentaria diphylla*
Mayapple - *Podophyllum peltatum*
Solomon's Seal - *Polygonatum biflorum*
Blue Cohosh - *Caulophyllum thalictroides*
Large-flowered Trillium - *Trillium grandiflorum*
Spring Beauty - *Claytonia virginica*
Trout Lily - *Erythronium americanum*
Bloodroot - *Sanguinaria canadensis*

6. Birds found in old growth forests should include at least 5 of the species listed below:

Ovenbird
White-breasted Nuthatch
Black-and-white Warbler
Scarlet Tanager
Hairy Woodpecker
Pileated Woodpecker
Wood Thrush

EASTERN RED AND WHITE PINE FORESTS [*2, 3]

These forests usually have mixed composition, with both coniferous and deciduous species. They contain red and/or white pine and may be found in association with black and white spruce, balsam fir, white and yellow birch, red and sugar maple and eastern white cedar.

1. Live tree density is indicated by a minimum of 9 tree /ha that are 140 years old or older. The average basal area of live trees is 45 m2/ha.

2. The minimum number of large logs (downed woody debris) required for old growth forests is 10 large logs (at least 25cm DBH and at least 8 m long) per ha. The average volume of dead wood is 106 m2/ha.

3. The minimum number of snags (greater than 10cm DBH and greater than 2m tall) required for old growth is 30 snags/ha.. The average basal area of snags is 5 m2/ha.

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CODE OF ETHICS
FOR OLD GROWTH FOREST EXPLORERS

The following is a set of guidelines for behaviour while exploring in any forest but particular care should be taken when studying old growth forests because of their scarcity.

1. Respect the forest and everything found in it.

2. Remove everything that you bring into the forest. Do not leave any garbage behind.

3. Be sure to remove all non-biodegradable flagging tape if you will not be returning to the study area.

4. Snags (dead standing trees) are extremely important habitat for many different wildlife species. They are not useless, dead trees. Please leave them standing and please be careful around them.

5. Treat all wildlife with respect. Observe them passively from a distance and try not to disturb them. If you find a bird's nest or other wildlife gems, feel free to observe but please leave it where you find it.

6. Try not to trample the forest floor. A great deal of damage can be done to a small area by a large group of people. Be particularly careful if you are in an area that is frequently visited by other people.

7. Be careful not to knock lichen and mosses off bedrock outcrops. Not only are they slippery and dangerous but they are also the first stage of soil development. They take years to re-establish.

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